

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

January 7, 2015

Flight Data Recorder

Specialist's Factual Report

1. EVENT SUMMARY

Location: Bagram Air Base, Bagram, Afghanistan
Date: April 29, 2013
Aircraft: Boeing 747-400
Registration: N949CA
Operator: National Airlines
NTSB Number: DCA13MA081

On April 29, 2013, about 1527 local time, a Boeing 747-400, N949CA, operated as National Airlines flight 102, crashed shortly after takeoff from the Bagram Air Base (OAIX), Bagram, Afghanistan. All seven crewmembers onboard were fatally injured and the airplane was destroyed from impact forces and post-crash fire. The 14 Code of Federal Regulations (CFR) Part 121 Supplemental cargo flight was destined for Dubai World Central – Al Maktoum International Airport (OMDW), United Arab Emirates.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened for this event.

3. FDR CARRIAGE REQUIREMENTS

The event aircraft, N949CA, was manufactured in January, 1993, and was operating such that it was required to be equipped with an FDR that recorded at a minimum 34 parameters, as cited in Title 14 CFR Part 121.344d.

4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **Honeywell 4700 128 wps**
Recorder Serial Number: **unknown**

4.1. Honeywell SSFDR Description

The Honeywell Solid State Flight Data Recorder (SSFDR) records airplane flight information in a digital format using solid-state flash memory as the recording medium. The SSFDR can receive data in the ARINC 573/717/747 configurations and can record a minimum of 25 hours of flight data. It is configured to record 128 12-bit words of digital information every second. Each grouping of 128 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as

either subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 128-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number within the subframe. The SSFDR is designed to meet the crash-survivability requirements of TSO-C124.

4.1.1. Recorder Condition

Upon arrival at the flight recorder laboratory, it was evident that the FDR had incurred damage during the accident sequence. The Crash Survivable Memory Unit (CSMU) was the only part forwarded to the lab and it had separated forcefully from the chassis (figure 1).



Figure 1. FDR CSMU

The CSMU was opened and the memory board was extracted and inspected for damage. The board appeared to be in good condition. The board was attached to a surrogate recorder unit and the memory contents were downloaded (figure 2).

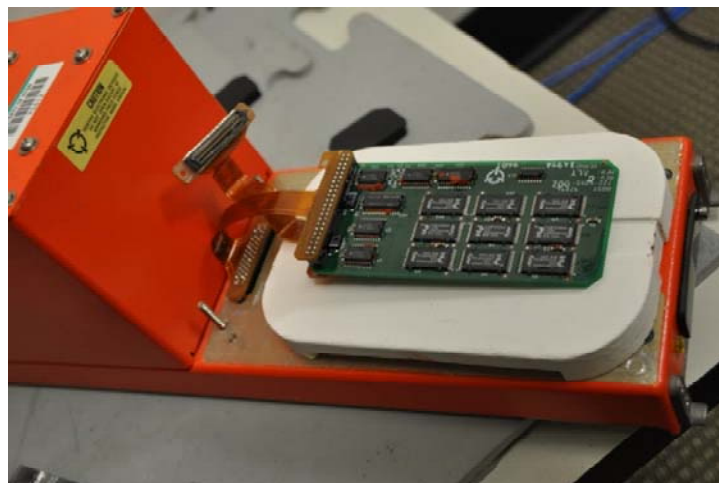


Figure 2. Memory Board in Surrogate

4.1.2. Recording Description

The recorder download file was 18.3 MB. The FDR recording contained over 25 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The accident takeoff was the last recording and its duration was approximately 15 minutes from power up to the end of recorded data. The parameters evaluated for the purpose of this report appeared to be in accordance with the federal FDR carriage requirements.

The plots and tabular file include data up until the last second of data retrieved. Some of the initial samples during this final second of data were valid but latter samples were invalid and should not be considered data representative of accurate conditions.

In this aircraft, the FDR is located in the aft equipment area above and behind the left aft entry door. The FDR is powered by 115 volts AC from the AC Bus 3. The FDR will not record continuously but instead is dependent on power logic to start/stop recording. Under normal circumstances, the unit in this aircraft records when either engine is producing power and the integrity of the wiring from the power generating source is maintained to the unit.

4.1.3. Engineering Units Conversions

The aircraft was originally delivered with a tape-based FDR and at some point was upgraded to a solid state unit. The dataframe was in accordance with Boeing document D243U316-206.

The engineering units conversions used for the data contained in this report are based on documentation from the operator and aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).¹

There were over 600 parameters recorded. The entire recording included the accident flight takeoff, the previous flight from Camp Bastion, Afghanistan to Bagram (over an hour) and several longer previous flights. This report contains data from the accident flight and the previous flight. Appendix A lists the FDR parameters verified and provided in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to Greenwich Mean Time (GMT), was established with an offset provided by the CVR specialist. For more information, see Factual Report, Cockpit Voice Recorder.

Accordingly, the time offset for the event flight data from SRN to GMT is the following: GMT = SRN – 58523 seconds after midnight. The FDR stopped recording between the

¹ CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

previous flight and the event flight so the correlation differs for the previous flight. The time offset from SRN to GMT for that flight is the following: $GMT = SRN - 63435$.

4.3. FDR Plots and Corresponding Tabular Data

On the day of the accident April 29, 2013, the FDR on N949CA began recording around 07:50 GMT². The aircraft taxied and took off at 08:04 from runway 19. The maximum pitch angle after rotation was 17 degrees. The aircraft continued to climb, reached a cruise altitude of around 29,000 feet at 08:30 and began to descend about 20 minutes later. During the descent, there were some perturbations noted in the acceleration parameters, ranging from +.62 g's to +1.36 g's in the vertical acceleration parameter. The aircraft landed at Bagram on runway 03 at 09:09. The minimum longitudinal acceleration parameter value recorded during landing was -.27 g's. The flight time was one hour and five minutes. The last recorded fuel quantity was 46,200 pounds and the gross weight was 617,280 pounds. The FDR stopped recording at 09:19:28.

For the accident flight, the FDR began recording again at 10:41:23. The total fuel quantity was 106,000 pounds and gross weight recorded was 677,120 pounds. The flaps were lowered to 10 degrees at 10:44, the leading edge flaps were extended and a flight control check was performed. The aircraft taxied, lined up on runway 03 and made the last radio call before takeoff at 10:55:47. At 10:55:54, the N1 for all four engines began to increase, reaching full power at 10:56:11. Beginning at 10:56:33, at an airspeed of 137 knots, the pitch parameter began to increase. At 10:56:40, there was a slight right roll recorded of +2 degrees right and at 10:56:42, there was one sample of the air-ground sensor transitioning from ground to air at an airspeed of 163 knots. The air-ground sensor toggled between air and ground over the next 1.5 seconds.

The last recorded data point on the FDR occurred at 10:56:45, although information from other sources indicate the flight continued past this time. The airspeed was 171 knots, the pitch attitude was 13 degrees, roll was +4 degrees right and the radio altitude measured 33 feet. The gross weight was 675,200 pounds. The CVR ceased recording at approximately the same moment as the FDR.

The entire recorded portion of the event flight was just over 15 minutes. There were no indications of abnormalities based on the FDR parameters reviewed prior to end of data nor any warnings noted. There were no AP cautions, AP warnings or Master cautions during the recorded portion of the flight. From power up to end of data, all the gear parameters indicated the landing gear was down and locked. The FDR records the pressure of hydraulic systems 1, 2, 3, 4. From FDR power up to end of data, the pressure of all 4 systems registered around 3,000 psi and there were no low pressure warnings recorded. There is no indication from the FDR data why the unit stopped recording.

The following eight figures contain FDR data from the accident aircraft. Figure 3 shows basic parameters during the accident flight takeoff. Figures 4-9 show select parameters during the entire accident flight segment. Figure 10 contains basic parameters recorded during the previous flight.

² All times are GMT for remainder of report.

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page. The corresponding tabular data used to create the plots from the accident flight are provided in electronic (*.csv³) format as Attachment 1 to this report and tabular for the previous flight plot is in Attachment 2.

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³ Comma Separated Value format.

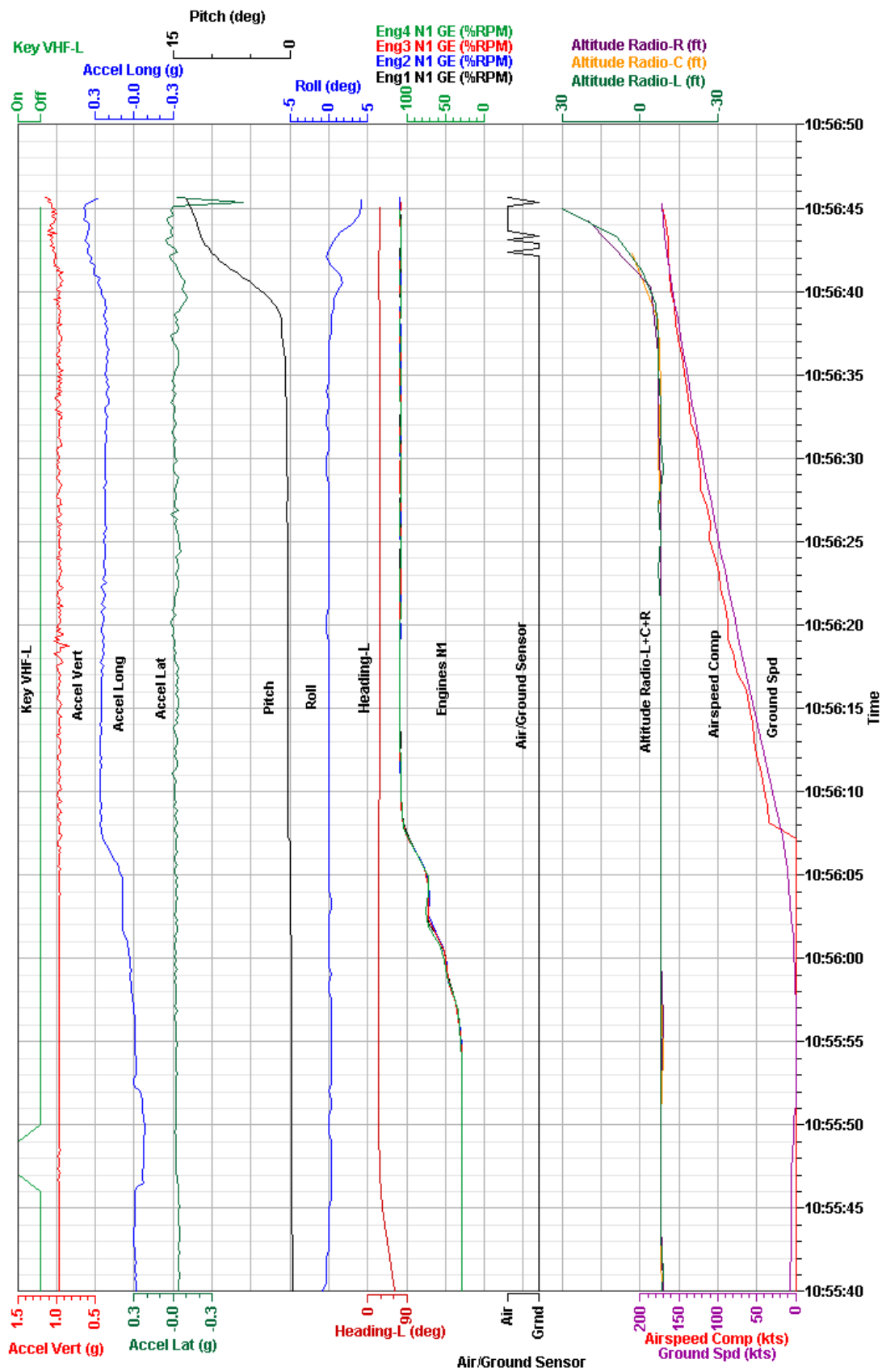


Figure 3. Basic parameters - expanded takeoff

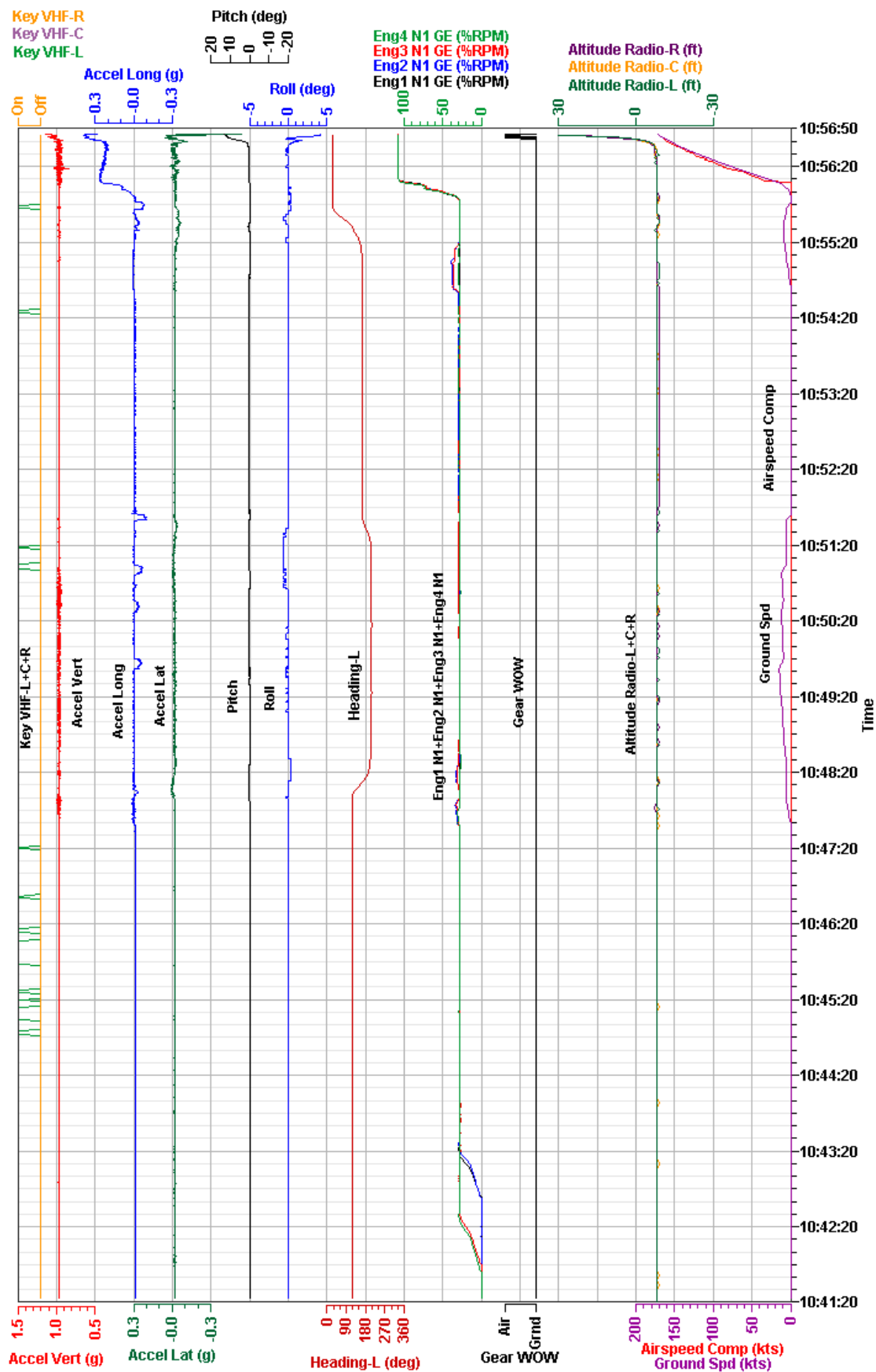


Figure 4. Basic parameters - entire flight

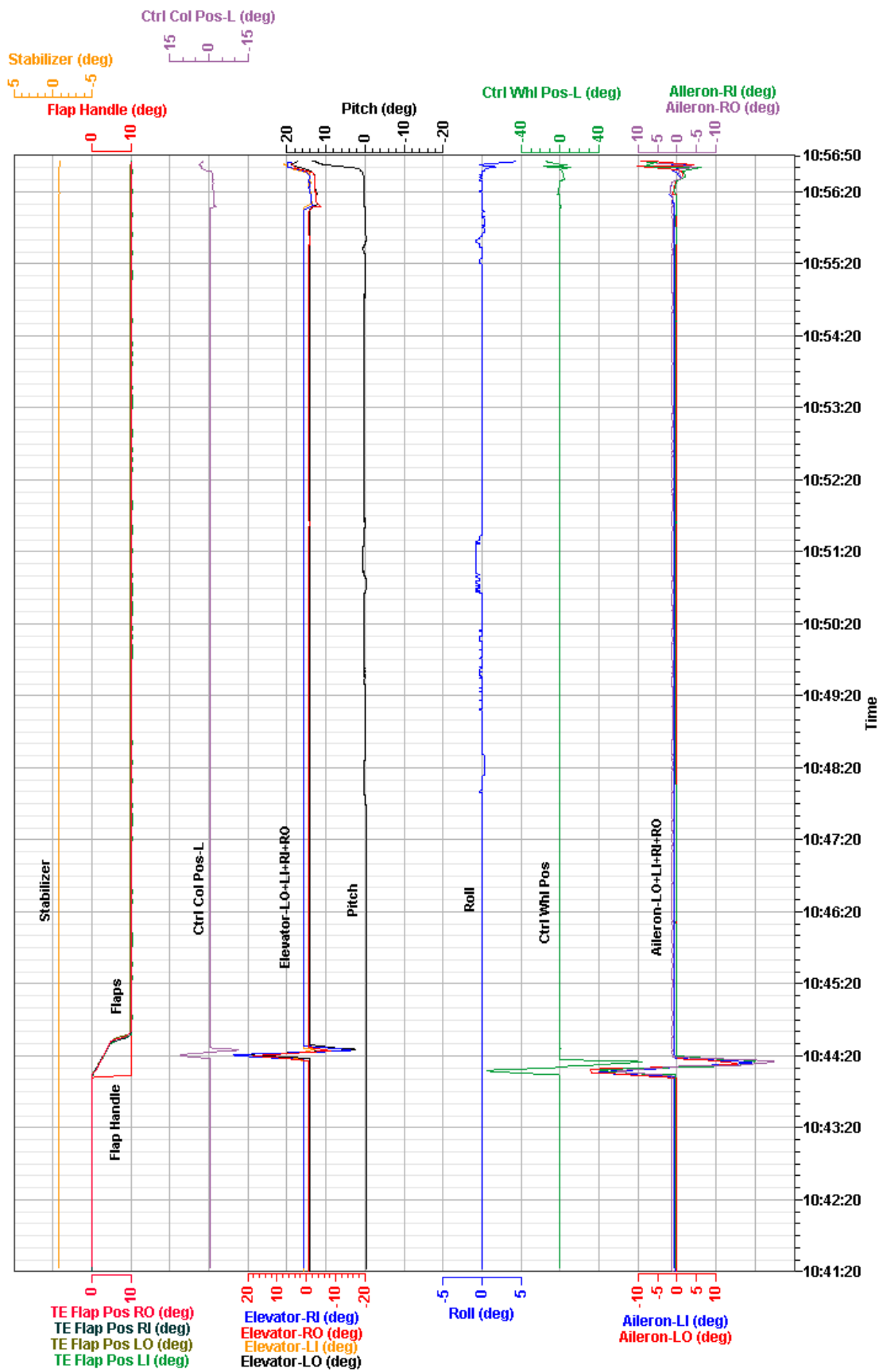


Figure 5. Flight controls - entire flight

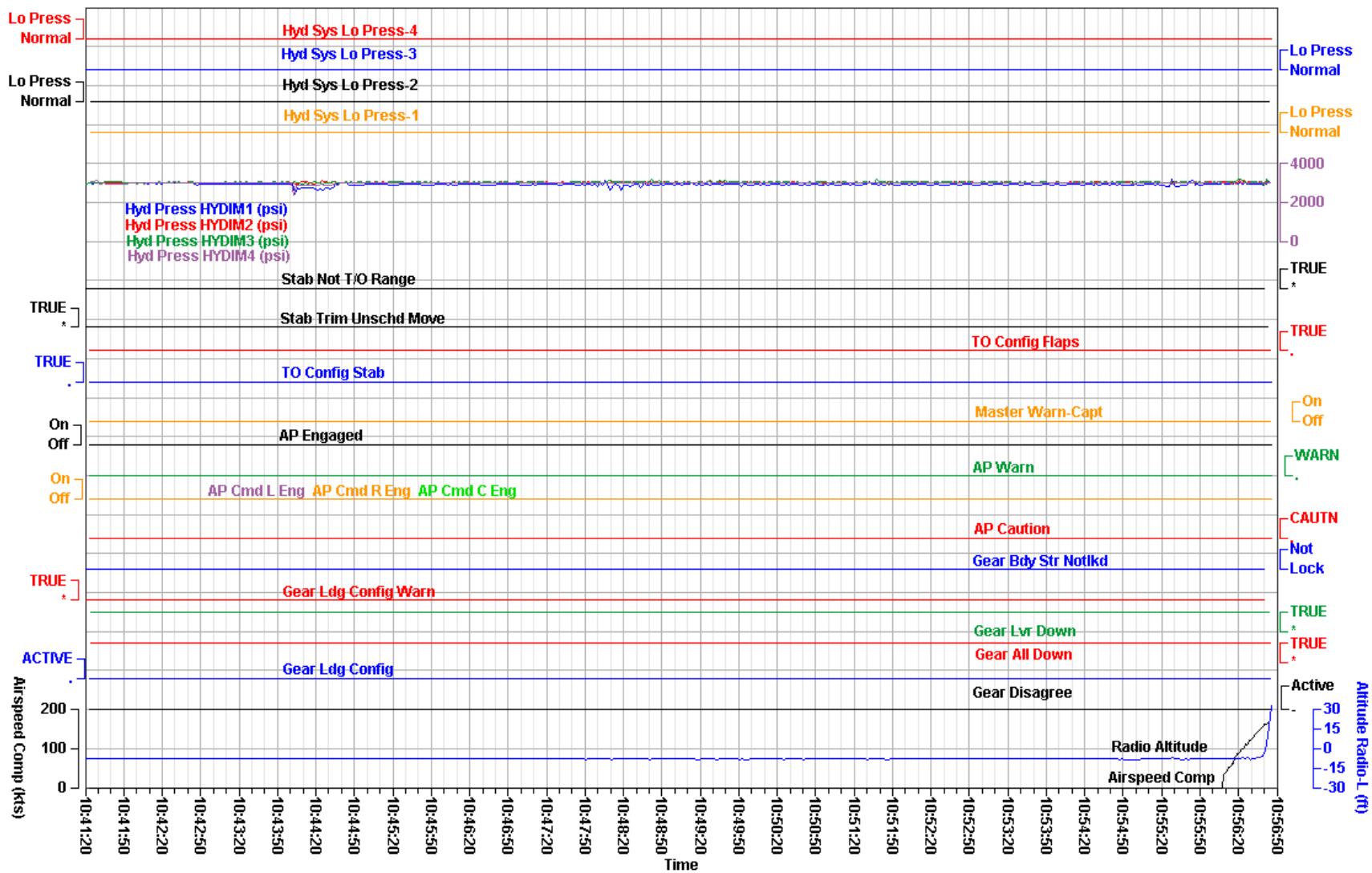


Figure 7. Discretes - entire flight

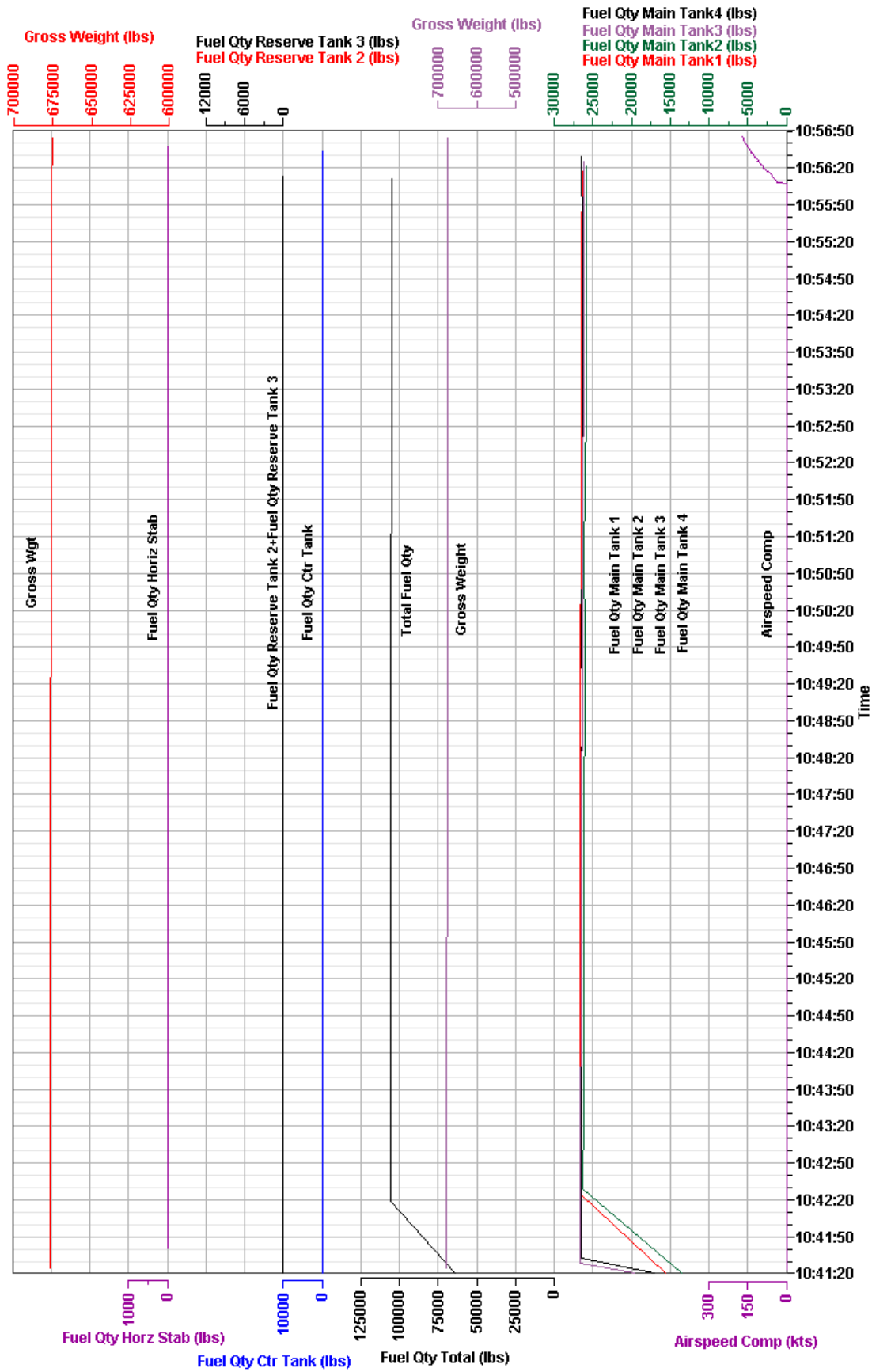


Figure 8. Fuel - entire flight

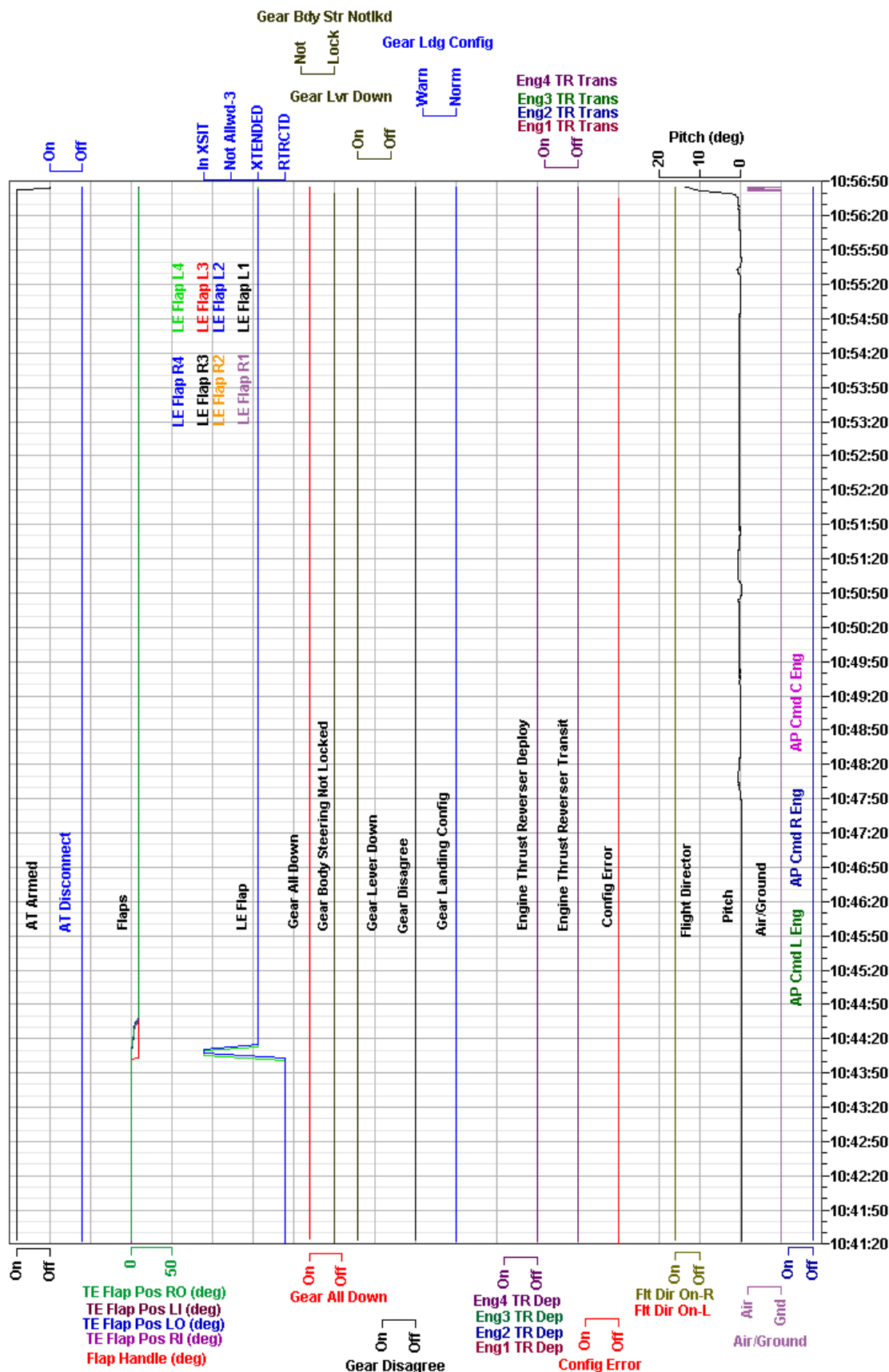


Figure 9. Configuration - entire flight

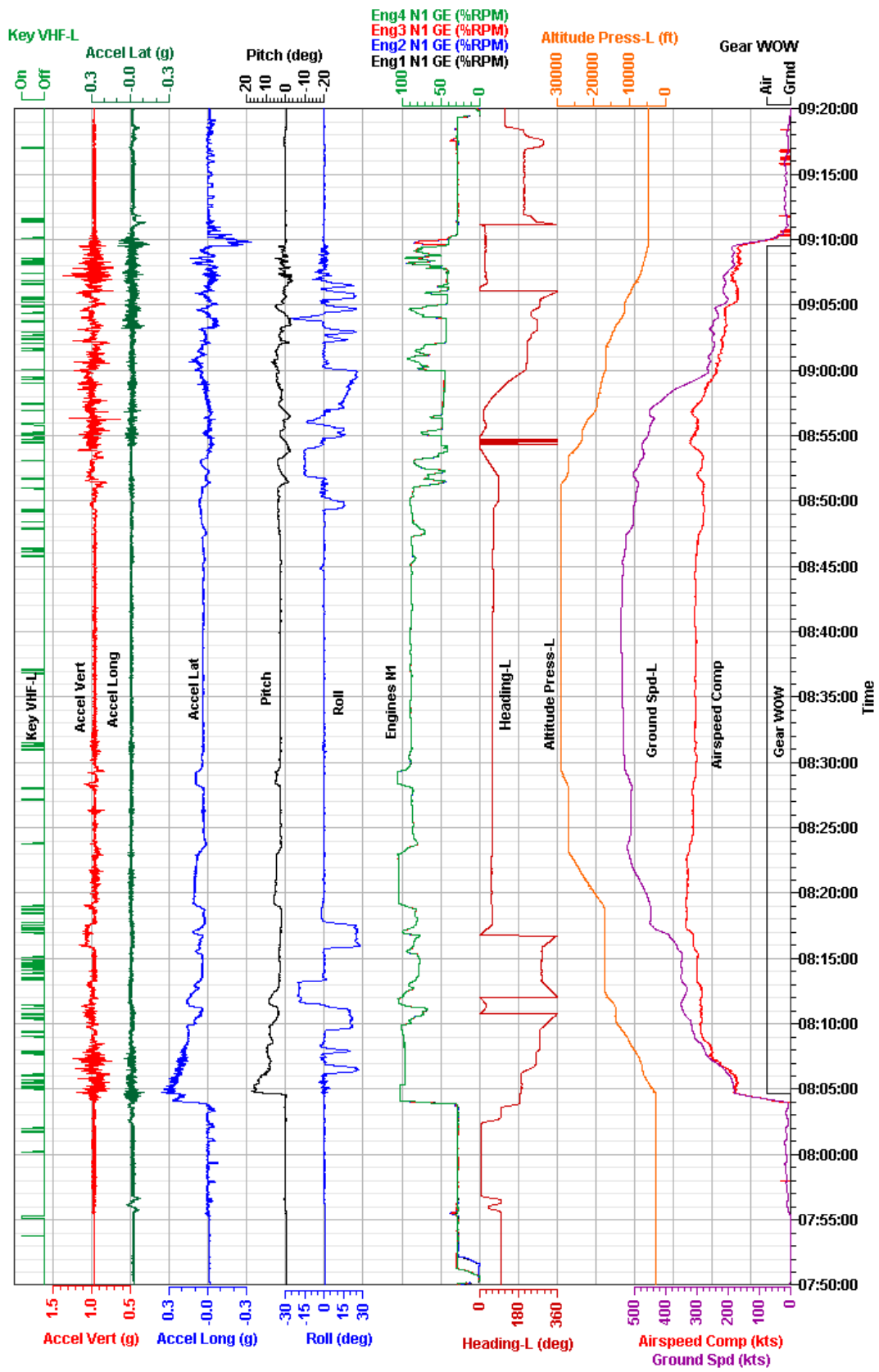


Figure 10. Basic parameters - previous flight

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

Parameter Name	Parameter Description
1. Accel Lat (g)	Lateral Acceleration
2. Accel Long (g)	Longitudinal Acceleration
3. Accel Vert (g)	Vertical Acceleration
4. Aileron-LI/LO (deg)	Left Inboard/Outboard Aileron Position
5. Aileron-RI/RO (deg)	Right Inboard/Outboard Aileron Position
6. Airspeed Comp (kts)	Computed Airspeed
7. Altitude Press (ft)	Pressure Altitude
8. Altitude Radio (ft)	Radio Altitude
9. AP Caution (discrete)	Autopilot Caution
10. AP Cmd Eng (discrete)	Autopilot Command Engaged
11. AP Engaged (discrete)	Autopilot Engaged
12. AP Warn (discrete)	Autopilot Warning
13. AT Armed (discrete)	Autothrottle Armed
14. AT Disconnect (discrete)	Autothrottle Disconnect
15. AT Thrust Ref Annun (discrete)	Autothrottle Thrust Reference Annunciator
16. Config Error (discrete)	Configuration Error
17. Ctrl Col Pos-L (deg)	Left Control Column Position
18. Ctrl Whl Pos-L (deg)	Left Control Wheel Position
19. Elevator-LI/LO (deg)	Left Inboard/Outboard Elevator Position
20. Elevator-RI/RO (deg)	Right Inboard/Outboard Elevator Position
21. Eng 1/2/3/4 EGT (degC)	Engine Exhaust Gas Temperature
22. Eng 1/2/3/4 Fuel Flow (lbs/hr)	Engine Fuel Flow
23. Eng 1/2/3/4 N1 (%RPM)	Engine N1
24. Eng 1/2/3/4 N1 Thrust Cmd (%RPM)	Engine Thrust Command
25. Eng 1/2/3/4 N2 (%RPM)	Engine N2
26. Eng 1/2/3/4 TR Dep (discrete)	Engine Thrust Reverser Deploy
27. Eng 1/2/3/4 TR Trans (discrete)	Engine Thrust Reverser Transit
28. Flap Handle (discrete)	Flap Handle
29. Flt Dir On-L/R (discrete)	Left/Right Flight Director On
30. Fuel Qty Ctr Tank (lbs)	Fuel Quantity Center Tank
31. Fuel Qty Horz Stab (lbs)	Fuel Quantity Horizontal Stabilizer
32. Fuel Qty Main Tank 1/2/3/4 (lbs)	Fuel Quantity Main Tank 1/2/3/4
33. Fuel Qty Reserve Tank 2/3 (lbs)	Fuel Quantity Reserve Tank 2/3
34. Fuel Qty Total (lbs)	Fuel Quantity Total
35. Gear All Down (discrete)	Gear All Down
36. Gear Bdy Str Not Lkd (discrete)	Gear Body Steering Not Locked
37. Gear Disagree (discrete)	Gear Disagree
38. Gear Ldg Config (discrete)	Gear Landing Configuration
39. Gear Ldg Config Warn (discrete)	Gear Landing Configuration Warning

Parameter Name	Parameter Description
40. Gear Lvr Down (discrete)	Gear Lever Down
41. Gear WOW (discrete)	Gear Weight On Wheels
42. Gross Weight (lbs)	Gross Weight
43. Ground Spd (kts)	Ground Speed
44. Heading-L (deg)	Left Magnetic Heading
45. Hyd Press HYDIM 1/2/3/4 (psi)	Hydraulic Pressure 1/2/3/4
46. Hyd Sys Lo Press-1/2/3/4 (discrete)	Hydraulic System Low Pressure 1/2/3/4
47. Idle Thrust Annun (discrete)	Idle Thrust Annunciator
48. Key VHF-L/C/R (discrete)	Left/Center/Right Microphone Keying
49. LE Flap L/R 1/2/3/4 (deg)	Left/Right Leading Edge Flap Position
50. Master Warn-Capt (discrete)	Master Warning Captain
51. Pitch (deg)	Pitch Angle
52. Roll (deg)	Roll Angle
53. Stab Not T/O Range (discrete)	Stabilizer Not in Takeoff Range
54. Stab Trim Unschd Move (discrete)	Stabilizer Trim Unscheduled Move
55. Stabilizer (deg)	Stabilizer
56. Stick Shaker #1/#2 (discrete)	Stick Shaker 1/2
57. TE Flap Pos LI/LO (deg)	Left Inboard/Outboard Trailing Edge Flap Position
58. TE Flap Pos RI/RO (deg)	Right Inboard/Outboard Trailing Edge Flap Position
59. Thrust Mode Annun (discrete)	Thrust Mode Annunciator
60. TO Config Flaps (discrete)	Flaps Takeoff Configuration
61. TO Config Stab (discrete)	Stabilizer Takeoff Configuration

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
kts	knots
g	g
discrete	discrete
degC	degrees Celsius
ft	feet
lbs	pounds
lbs/hr	pounds/hour
psi	pounds per square inch
%rpm	percent revolutions per minute

NOTE: For parameters with a unit description of discrete, a discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.